JPRS 77535

9 March 1981

East Europe Report

SCIENTIFIC AFFAIRS

No. 696

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ROUNDTABLE DISCUSSES STATUS OF RESEARCHERS

Budapest IFJUKOMMUNISTA in Hungarian Nov 80 pp 4-7

[Article by Peter Barok: "From the Career's Beginning Until it Develops -- Is Being a Researcher a Luxury?"]

[Text] Roundtable Discussion with Researchers and Development Workers

KISZ [Communist Youth League] leaders of the research facilities recently gathered for a conference organized by the KISZ Central Committee EFT [Intellectual Youth Council] in Rackeve. At this conference treatises were presented about timely questions of scientific policy and science organization, about past experience and acute problems. Lively debates developed at the 3-day conference -- both at general sessions and in committees. Practically everyone participated and expressed an opinion in these debates. The great activity proved two things to me. One: many problems and concerns make it more difficult for young researchers to embark on their careers, to find their riches and to make professional progress. The other: these young people are participating responsibly and with great resolve in solving the problems. We would like to continue the discussion here about some detail issues of this exchange of ideas.

Participants of our roundtable discussion were: Mrs Laszlo Kopf, KISZ Central Committee secretary, and president of the Intellectual Youth Council; Gyorgy Darvas, leader of the working committee of young researchers operating with the EFT (MTA [Hungarian Academy of Sciences] Science Organization Group); Mrs Katona nee Judit Doczi (Higher Educational Pedagogy Research Center); Csaba Kund (Telecommunication Research Institute); Endre Molnar (MTA Soil Studies and Agrochemical Research Institute); and Peter Mihaly (MTA Economic Science Institute).

Mrs Laszlo Kopf: Based on the KISZ Central Committee's action program we have dedicated the 1980-1981 activity year -- and within this primarily 1980 -- in the Intellectual Youth Council's program to the problem area of young researchers. The Ninth KISZ Congress has resolved that in the coming years the relationship between young intellectuals and the Youth League must be strengthened; the various forms and methods of this activity must be worked out. This work was actually begun at that time. First of all we created the organizational conditions. The Intellectual Youth Council was created, then the various working groups working with the council were formed. The sequence of forming the working committee followed approximately the same rate and tendencies, as the EFT was able to assign more energy to the KISZ projects being carried on in the various intellectual microstrata significant and important also from the social viewpoint. We began with the teachers, then the physicians were next, followed by the technology people, economists, the agricultural professionals, young artists, and so on. The working committee of young researchers was formed in 1977. In addition to solving the movement's actual problems, it also continuously evaluated the situation of this youth microstratum. A realistic evaluation was made of the concerns and problems of this intellectual group and of the experience of the work the Youth League has done among them. In January of this year, the KISZ KB's executive committee defined the tasks ahead of them on the basis of this situation analysis. The work now is being implemented on the basis of this decision. At the Rackeve conference we reported on the Executive Committee's decision, and jointly interpreted the defined tasks with those KISZ organization leaders who work in this area.

The "year of the researchers" successfully joined the activity under way now in our society in the interest of increasing the rationalization, modernization and efficiency of research. We are eager to contribute to this work with the unique means of the Youth League Movement, as this process will help define and implement our own tasks also.

Recently we have also organized quite a few actions which directed the attention of KISZ organizations to this important intellectual group and which at the same time also provided young researchers and development workers with a professional, political and movement program.

Last year and also this year we organized sports days for the research institutions and jointly with the MTA's science organizations group we organized a series of conferences. Our experience shows that these events are needed, they serve well the interests of the intellectual stratum, strengthen the links between young people working in this area and the KISZ organizations operating elsewhere and also increase their effect among youth working outside of the KISZ.

[Moderator Barok] I suggest we continue with starting the career. I think it is not without educational value if you would start out with the circumstances of how your own career began.

Mrs Katona, nee Judit Doczi: Perhaps I would begin with education. In the arts department -- at least in the freshmen and sophomore years -- some teams form by grouping around one or another better known professor who is recognized in his field and these do their work under his guidance. All these teams are very creative and are made up of young people whom one views even during the university years as potential researchers. This type of sensible, meaningful work is carried on until the middle of the third or fourth year, but after this the struggle for the job begins, a struggle which absorbs all their energy. By the time they reach the fifth year, these groups consisting of capable young people dissolve. The reason for their dissolution is first of all the uncertainty, since they have no idea where they will finally be able to continue the type of work they began at the university.

They also do not know what type of research on what topics is being done in which research institution. The selection and employment systems also strengthen the uncertainty and chancy nature [of this]. Further, if in spite of this someone is hired for a research job, even here he does not always find out what is expected of him and what he is to do. In my opinion, the conditions of being hired for research jobs should be changed, that is, made more specific. A system of requirements should be worked out which would contain what a researcher must learn, for example, in the first 5 years. Or, on what basis does someone qualify? As I see it, the means and format for this kind of objective qualification do not yet exist today in the social science institutions.

Endre Molnar: I would also emphasize the role of chance. I went to a high school specializing in chemistry and biology; this school was the university's practice-teaching high school. That is when I decided that, if possible, I would do chemical research. I had several -- at least three -- opportunities as a result of the application system. One of these panned out. I told the institute's director when I was hired: I have basic training in the natural sciences, if this can be used here, I will also try everything in the interest of acquiring the basic knowledge required for my work. We accepted each other's conditions, and I started to work.

According to the qualification system of the institutes belonging under the Academy, either party can say in every 3 to 5 years: "This is not what I expected, let's part company." I have been working here for 6 years. It seems I have succeeded in learning many things. Yet it could have been easier if I could have prepared for this career in the institution of higher learning. I was a one-discipline chemist, about whom the laics say research chemist; but I had no idea about this work, about these opportunities. At the present time, no training exists either in higher level agricultural education or in higher level natural sciences education which would make it possible for researchers who are hired by the institution not to have to spend their first 3 years in postgraduate training. Thus during these 3 years he cannot contribute anything to the research topics, since he must study.

Csaba Kund: What is the decisive factor in selecting one's place of employment? Primarily, chance. I submitted my application to three places, to three industrial enterprises. Some did not even pay me the courtesy of a reply. In the meanwhile one of my classmates who applied to the Telecommunications Research Institute said that they were working on an interesting measuring project for which they need one or two people. Of those who had been picked, someone's acquaintance did not take the job, after which they contacted me. This is how I got into the institution.

Peter Mihaly: I consider it to be quite natural that any society cannot, and is not even willing, to pay as much to a young person of 20-odd years who has just left the university and begins to do research, as to another youth of the same age who, for example, imports computers at a foreign trade enterprise...simply because the two do not produce in comparable quantities. One of them is performing his job well, while it has not yet been learned about the other one whether or not he will be a good researcher. This contradiction could be resolved by legalizing this system: If it were recognized that indeed there is a stage of postgraduate training and this is a sacrifice by the one who is doing it. He does receive some money, enabling him to live, but not as much as a "decent salary." I have heard that this is more or less they way it already is in the technological area. This would also be needed in the area of social sciences. To be a young researcher in my area today -- perhaps this will be a strong term -- is financial luxury. Of classmates, everyone who is not a researcher makes at least 1,000 forints more [per month]. Fortunately I am in a situation where I can afford it, just as my colleagues can with whom I work in the institute. One can argue about whether this is good or not, but the fact is that this is how it is.

[Moderator Barok] So the young person works there in some institute. What next? What are his opportunities for professional growth, for financial advance? What are his contacts with the educational institutions? What makes him feel satisfied, or dissatisfied?

Gyorgy Darvas: I would approach the topic area of being appreciated and satisfied primarily from the angle of requirements and performance. Years ago the scientific policy committee worked out a system of requirements in which there are some precisely defined criteria. Using these, the activity of researchers could be objectively evaluated. In my opinion, the problem is that this exists only on paper and it is not being used in practice. I am convinced that implementation of the system of requirements is hindered by subjective factors, not by objective ones. In research facilities every worker must be evaluated every 3 years, and this is the time the decision should be made as to whether he is to continue being employed as a researcher, or is to be advised to continue his career in some other kind of employment. This evaluation should be conducted by that generation of researchers which now works in positions of leadership, or which -- by virtue of age -- is considered to be the "old" guard at the institutes. The majority of them came to the research institutes in the mid-1950's when most of the institutes were established, and when the number of people employed in research institutes sharply increased. As I see it, this generation has become quite rigid in the institutes. There are very many among them about whom it has been proven a long time ago that they are not productive, that they are not suitable for a researcher's career. Of course, consistent implementation of the evaluation system is only one of the tools of promoting more efficient activity.

What compensates for such low financial appreciation of the work of young researchers? The quite strong social prestige associated with research work and with a research career still exists today, even though it is on the decline. A researcher's work enjoys prestige, or imagined prestige, and this still attracts many young people to this field -- those who can afford it financially. The study we conducted a few years ago showed that this results in a very strong counterselection. Moving upward in our educational system, the ratio of children of the strata with lower incomes -- and within this, primarily of physical workers -- decreases significantly. This occurs even more strongly in the field of research, since the ratio of those who can afford this luxury is low.

Mrs Katona, nee Judit Doczi: I think that in our institute the researcher would have a feeling of satisfaction if someone paid attention to the results he achieved. If he at least received a report on whether or not the results of his research were put into use.

I consider the contact between the research institutes and the educational institutions to be very poor. Even though at our place we do have the legal possibilities, we can teach in institutions of higher learning, but in practice this depends primarily on the right personal contacts. I do teach at the unviersity, but only because I had connections helping me to do so. I consider this situation to be bad because there is a threatening danger of practice and theory breaking completely away from each other.

Csaba Kund: My experience is more pleasant. The relationship between the institute and the technical university is extremely good; we have succeeded in building not only official but also personal relationships. Many of us have classes at the technical university. The relationship's quality also has an influence on accepting the young people, and on working with them.

No one pattern applies to the relationship between the older and younger people. There are some older colleagues in our institute who, when they find an interesting article, carefully hide it to make sure no one has a chance to see it; but at the same time there are also those who -- if someone asks them for it -- provide such material and so much of it that the person requesting it can hardly cart it away. The real problems occur when some larger or smaller groups do not have enough work. Experience shows that as long as we have a sensible assignment, we have no problems of a personal nature.

Gyorgy Molnar: I agree that professional satisfaction is the most important element of feeling generally well. And one thing is closely related to this: appreciation of the work done. Even if the alternative we worked out were not accepted, at least they should tell us why not. A huge number of research reports are made for the files or desk drawer right off the bat. What should provide the desire for an older, or younger researcher to work if no one cares about what he produces? I could list examples all the way from the Academy to the OMFB [National Technical Development Committee]. It has happened that we prepared thorough -- and in my opinion, good -- material, to order. Five years later they came again, and ordered the same thing. We just took it off the shelf, put it on the table, and asked them: "If you paid for it, why didn't you at least read it?" Everyone, including the researcher, has to feel that what he does has some effect. If it is good, it will be used; if bad, at least he should be so informed.

[Moderator Barok] The things we have heard so far also prove that the Youth League determined correctly, and with good sense, the main direction of its activity among intellectuals. That is, the work done in this movement, this social acitvity among young researchers and developers can be approached primarily from the angle of professional activity and through that.

Mrs Laszlo Kopf: Undoubtedly, it is very difficult to find the movement's work formats corresponding to every strata, every area of interest, and to young persons with different educations and training. This is also true in the case of researchers and developers. The two starting points for the solution are: increased incorporation of the tasks deriving from the basic activity into the movement's work, and expanding and increasing the autonomous activities of the KISZ organizations.

Csaba Kund: At our place, social work is one of the best functioning elements of political work. It is obvious that the young people also have a direct interest in patronizing kindergartens and day-care centers . For this, people do not have to be "lassoed"; there always are volunteers.

The other important part of our activity is related to economic work, to advanced professional training. The professional event we organized last year, in which KISZ members of enterprises interested in sales to the Olympics participated, was very successful. Though indirectly, our institute participated in sales to the Olympics -- by providing components for microwave equipment -- therefore we felt competent to bring Budapest's telecommunications technology and electronics enterprises together for this event. Since this professional day was very successful, we continued this type of activity. Credit for the fact that the movement enjoys appreciation not only among the young people in our institute is also due in part to regularly organizing the above-mentioned professional days and conferences. The institute's professional public opinion values highly the initiative taken by the KISZ.

Gyorgy Molnar: I am in that fortunate -- or unfortuante -- situation that for 3 years I was simultaneously KISZ secretary in the basic organization, and also a member of the EFT working committee and of the borough's working committee. When our base group received the KISZ Central Committee Certificate of Commendation for the second time, the borough KISZ committee's secretary had the courage to say: "You people received this because you decided on and carried out things we did not even dare to put on paper."

Mrs Katona, nee Judit Doczi: I would mention a significant problem which influences the efficiency of the KISZ organization. In our institute the basic organization is made up of researchers. Difference in educational levels is a basic problem and an additional problem is created by the different working hours. Soving our problems is made more difficult by the fact that often borough KISZ committees still cannot give assignments to the KISZ organizations in research institutions suitable for the latter's characteristics. This is also why it has become our fundamental interest to tailor central programs to the circumstances of our own KISZ organization. We all do this, with greater or lesser success. Of course, it also has much to do with influencing success whether we speak about the large number of KISZ members of an institute which has 600 people, or about a 20-member organization of a smaller institute. My experience has been that the performance-oriented political acitivity which I otherwise consider to be good, is not implemented the same way in institutions with varying numbers of members and varying opportunities.

Gyorgy Darvas: The extent of heterogenity is truly large. The most important heterogenity factors are: the researchers and the strength of research assistance in a base organization; different base organizations with differing numbers of members are working in the various branches and areas of science, and in the various size institutes. There are a few thousand of us young researchers, and also because of this we cannot expect the KISZ Central Committee to develop work formats for us which can be applied on all levels and under all curcumstances. I think this can also be educational for the researcher work committee. Since even these two-thousand-and-some-hundred differ from each other to a large extent, I think the first task is to strengthen the independence of the KISZ organizations. Under no conditions can solution of the problems be expected "from up above." The differences between scientific branches have designated the various work areas and we have to conform to this in KISZ work too. Where, for example, the institute's work is closer to a factory's activity, different actions will have to be defined than, for example, at a research facility for the social sciences. While in the former case generally even the more spectacular community actions can be undertaken successfully, in the latter situation individual activity -- such as heading a study group, or leading a group in political discussions -- for which the people working there are more suitable due to their professional training, can be more valuable.

[Moderator Barok] Of course we cannot conclude the debate, since answering the questions we heard, or solving the problems, cannot be our jobs. Yet, we trust that the opinions stated here will be helpful to the right people in making their decisions.

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NEW TYPE OF FUNCTIONAL INTEGRATED CIRCUIT: THE THERMAL MULTIPLIER

Budapest HIRADASTECHNIKA in Hungarian Vol 31 No 12, 1980, pp 441-449
manuscript received 5 May 80

[Article by Vladimir Szekely, Dr, graduate electrical engineer, lecturer, Department of Electronic Devices, BME (Budapest Technical University)]

[Text] 1. Introduction

A new type of analog integrated circuit was developed in recent years at the Department of Electronic Devices. The circuit operates on the basis of the thermal principle, and is one of the group of so-called IC's [integrated circuits] of a functional character. The following circuit functions have been realized with its aid: fourth-power analog multiplication and analog squaring.

Insofar as its technology is concerned, the new circuit is compatible with the bipolar IC's. We prepared prototypes in the technological laboratory of our department and found that they perform as expected.

In this article we present the thermal multiplier integrated circuit. We first describe its operation and design, and then analyze its electrical parameters (sensitivity, limit frequency, linearity, and so forth). In addition to the theoretical calculations, we discuss experiences gained with measurements on experimental circuits. We end the article by describing a number of possible applications.

2. Thermal Functional Circuits

The literature of integrated circuits has discussed for some time the idea of utilizing the temperature-sensitivity of silicon wafers together with their thermal conductivity for the realization of special electrical functions. Figure 1a illustrates the principle of thermal circuits based on this approach. There is a heat-generating element (heater) at one point of the IC chip. It dissipates an amount of heat depending on the input signal. This heat propagates in the IC chip and heats an element located at a distance. One of the electrical properties of this element is heat-sensitive (sensor). This supplies the output signal of the functional unit. Figure 1b illustrates the block diagram of the system. The input signal is converted into a temperature signal via an electrical → thermal converter. The temperature signal proceeds in the silicon toward the sensor. The latter performs thermal → electrical conversion to generate the electrical output signal.

An earlier publication of W. T. Matzen and others [1] mentioned the possibility of thermal functional IC's. This article describes a simplified unidimensional treatment of the heat-conduction phenomena of interesting structures, and also mentions a number of possible applications. Among others, it discusses the application as low-frequency filters, feedback low-frequency oscillators, and others.

P. R. Grey and others published interesting articles on the problems of thermal functional IC's. Starting from the two-dimensional study of the IC chip, they provide guidelines for designing filters based on the thermal principle. They also present a realization of which the frequency response is described by a rational fraction function; this is of especial interest from the approximation point of view [2]. They discuss the so-called TSS (Temperature-Stabilized Substrate) circuits [3]. This is closely related to the subject of thermal functional IC's.

W. E. Ott discussed thermal functional circuits realizing analog squaring in several articles ([4],[5]). Figure 2 illustrates the scheme of the IC. The input voltage is connected to the resistor R_F, which then dissipates heat in proportion to U_{in}^2. The chip heats up in proportion to this. The temperature increase is sensed by the transistor created next to the resistor, because of a reduction in the opening voltage of the emitter-base. The circuit is suitable for the measurement of the effective value of time-dependent signals (RMS). The Burr-Brown corporation markets this for several years. Its disadvantage is that it responds slowly, requiring approximately one second.

In his article [6], G. Bosch describes the realization of the thermal-feedback oscillator. His paper is a valuable addition to the literature since it utilizes the Si pn transition or the temperature-dependence of the Si-Al contact for temperature sensing.

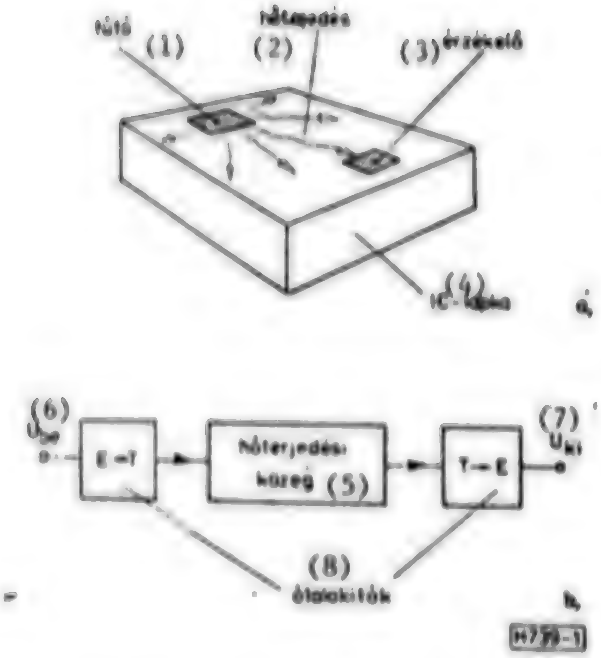

Fig. 1. Principle of the thermal functional circuit

Key:
1. Heater
2. Heat propagation
3. Sensor
4. IC chip
5. Heat-propagation medium
6. U_{in}
7. U_{out}
8. Converters

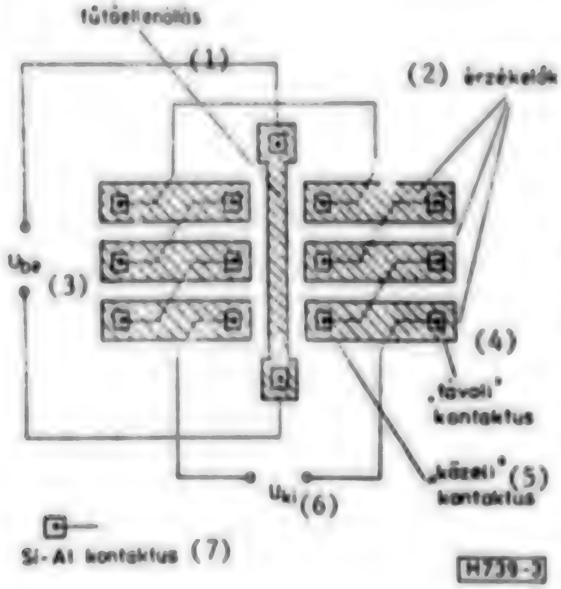

Fig. 3. Layout of the element with square transfer characteristic

Key:
1. Heater resistor
2. Sensors
3. U_{in}
4. "Distant" contact
5. "Close-by" contact
6. U_{out}
7. Si-Al contact

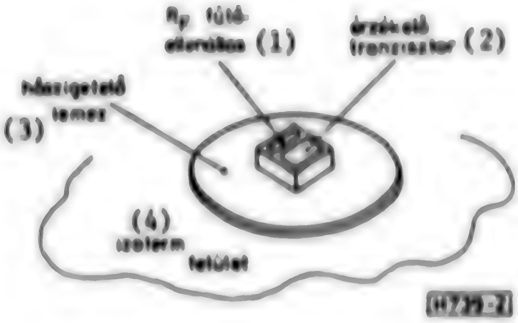

Fig. 2. The RMS meter based on the approach of W. E. Ott
Key: 1. Rp heater resistor
2. Sensing transistor
3. Heat-insulating plate
4. Isothermal surface

The principle of operation of the basic cell of the thermal multiplier we have realized, and about which we have published for the first time in 1976 [7], is the same as that of the RMS meter described by W. E. Ott. However, as a sensor we used the temperature-dependence of the contact potential (as did G. Bosch). We were the first to employ the thermal functional principle for the solid-state realization of multiplication.

3. Design of the Element With Square Transfer Characteristic

We have indicated above that we can readily create an element with QTC (quadratic transfer characteristic) with the aid of the thermal function principle. However, the design discussed there has the major disadvantage of being very slow: It takes approximately one second before it sets [4]. There are two reasons for this. First, the dissipating resistor and the sensing transistor cannot be placed close enough to each other — primarily because of the dimensions in the order of magnitude of 50 μm of the latter — second, the surface temperature of the IC chip stabilizes relatively slowly if we connect constant voltage to the input. This is so since the extent of temperature increase is affected not only by the Si chip but also by the thermal resistance of the capsulation. The latter has a higher mass and thus a higher thermal capacity, so that time constants of the order of magnitude of a second enter the time function of temperature stabilization. Another disadvantage of the approach described in [4] is that occasional calibration is required since the voltage U_{in} also changes as a function of the ambient temperature.

The aim of our design was to eliminate these disadvantages. To achieve this aim, it seemed desirable to replace the sensing transistor with a Si-Al contact, and using the thermopotential of this contact for temperature sensing. This solution has the advantage that the contact has small dimensions. As a result, the dissipating element can be located close to the sensing element. The distance between them may be twice the technological stripe.

Another, more important advantage is that the sensor using the Si-Al contact is actually of the differential operation principle: it always furnishes a voltage that is proportional to the difference between two temperatures. This is so since the silicon side of the Si-Al contact must also be extended, and this requires the use of other contacts which are farther from the dissipating element. Figure 3 illustrates this, among others. The output voltage is proportional to the thermopotential difference between the "close-by" and the "distant" contacts, meaning that it is proportional to their temperature difference.

The differential design improves the transient characteristics and the stabilization time of the device by several orders of magnitude. This is due to the following factors. Since the silicon is a good heat conductor, the temperature distribution establishes itself in the IC chip quite soon. As a result of the slow warming-up of the capsulation, the chip's temperature continues to increase but this no longer affects the distribution -- the temperature differences between the individual points. This means that the thermal time constant of components outside the chip (frame, capsulation) does not affect the sensor which provides the voltage proportional to the temperature difference. Ultimately, the stabilization time of the output voltage is reduced to the range of 10-100 μsec.

It is a pronounced disadvantage that the sensitivity of the sensor using the Si-Al contact is only about half of that of the transistor: 1 mV/°C compared to 2 mV/°C. But this sensor offers an obvious possibility for increasing the output voltage. By surrounding the dissipating element with sensors and connecting these in series, the output voltage increases by multiplication.

Figure 3 illustrates the layout of the experimental QTC element that was actually realized. The dissipating element is in the center, it is a diffused resistor. It is surrounded by the sensors on both sides. The solid-state side of the latter are conductor stripes formed by diffusion. It can be seen that there are six sensors in series in this design, so that the sensitivity is now six times as high. The circuit was realized with lines having a width of 12 μm. The substrate is n-type silicon, of approximately 1 Ωcm, in which we created the p-diffusion stripes by base diffusion (which is customary with bipolar IC's) at the same parameters. The square resistivity of diffusion was 200 Ω/□.

The most important parameters of the realized element with square transfer function are as follows:

$U_{out} = 0.034\ U_{in}^2$, mV/V^2

$U_{in\ max} = 13\ V_{eff}$

$U_{out\ max} = 5.5$ mV

$R_{in} = 2.1$ kΩ

$R_{out} = 5.5$ kΩ

The latter are linear ohmic resistivities.

Limit frequency: Approximately 10 MHz relative to the input signal, and 8 kHz relative to the 3 dB drop of the output signal.

4. Design of the Analog Multiplier

The function of analog multiplication can also be realized with the aid of the QTC element described in the preceding section. Let us consider the following algebraic equality:

$$U_a^2 - (U_a - U_b)^2 + U_b^2 = 2U_aU_b \qquad (1)$$

The three members left of the equal sign are, sequentially, the square of the voltage U_a, the square of the difference $U_a - U_b$, and the square of the voltage U_b. Thus, each member can be derived with the aid of an element each with square transfer function. We connect in series the outputs of these three elements -- also considering the signs of the left side of the equation (1). The resultant output then yields the right side of (1), so that it is proportional to the product of U_a and U_b.

Figure 4 illustrates the schematics of the connections. We can see the manner in which we took the signs of the left side of Equation (1) into consideration when connecting the outputs of the individual QTC elements into series.

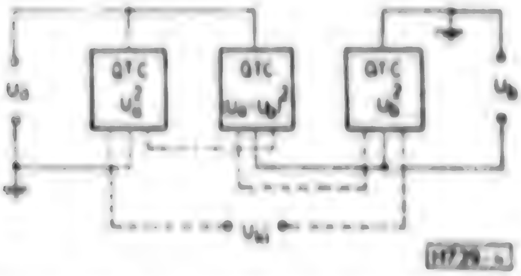

Figure 4. Three QTC elements connected as multiplier

In practical realization we have chosen the layout illustrated in Fig. 5.

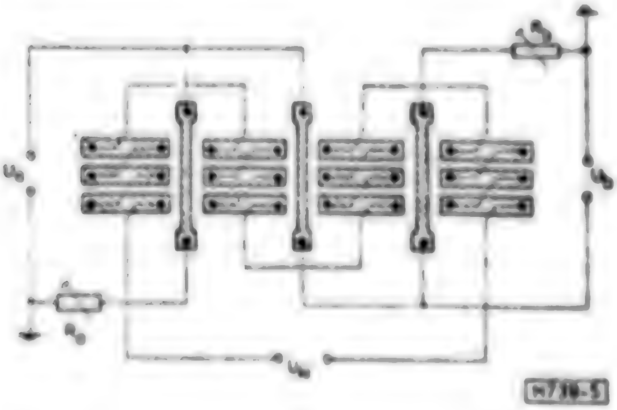

Figure 5. Layout of the realized multiplier

It can be seen that we used three QTC elements, as shown in Fig. 3, and it is also evident that we have combined the sensors of adjacent QTC elements. This became possible since -- as Fig. 4 shows -- the outputs of adjacent elements are in push-pull circuitry. The photomicrograph of the completed experimental circuit is illustrated in Fig. 6. The technological parameters are the same as those of the QTC element. We provided independent outlets for every dissipating element of the IC and

and for every sensor triplet. This was done solely because of the experimental character of the circuit. In later versions, most of the connections shown in Fig. 5 will be realized by IC metalization, so that the number of the required outlets will be merely six.

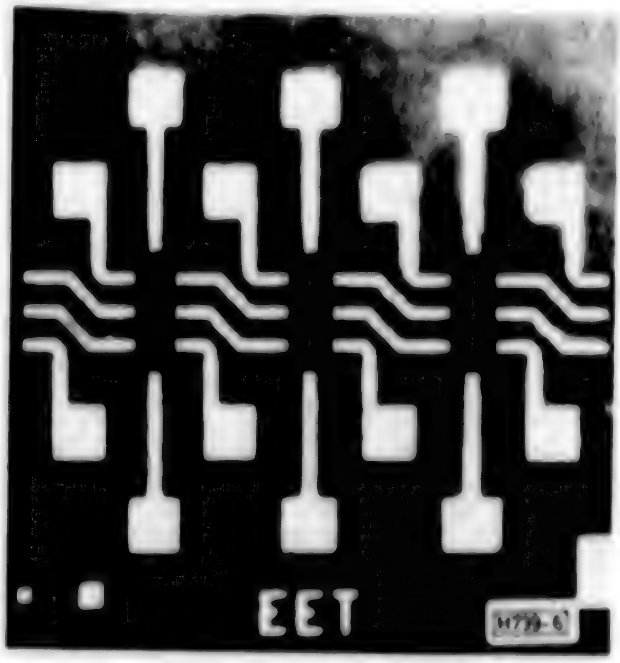

Figure 6. Photomicrograph of the multiplier circuit

The multiplier operates properly irrespective of the polarities of the two input voltages, meaning that it is of the so-called four-quarters type. Figure 7 illustrates the measured characteristic of the experimental circuit (as a function of the output voltage U_a, parameterized with U_b).

Minor deviations of the sensitivities of the three QTC elements might cause a small error in the linearity of the multiplier. To eliminate this problem, it is advisable to insert two trimmer resistors in the circuit, at the locations marked in Fig. 5 (R_a and R_b). The following are the major parameters of the realized multiplier:

$U_{out} = 0.06\ U_a U_b$, mV/V^2

$R_{in} = 1$ kΩ

$R_{out} = 11$ kΩ.

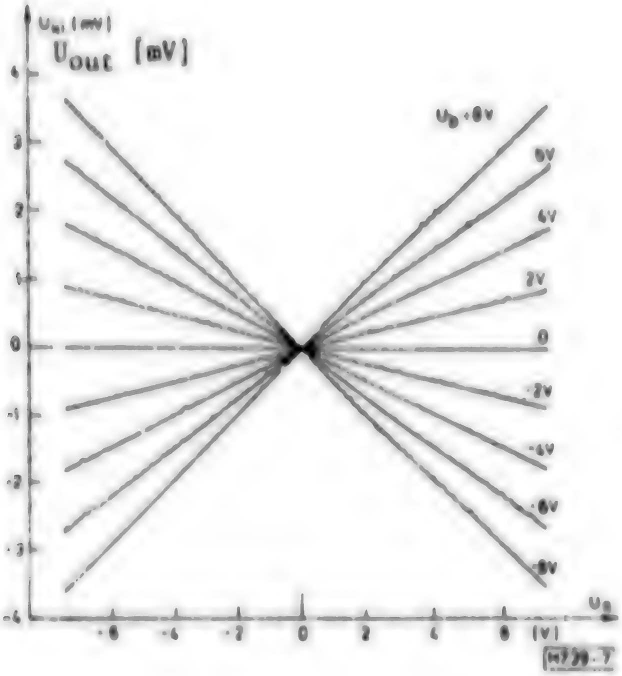

Figure 7. The measured characteristic of the multiplier circuit

Limit frequency: Same as for the QTC element.
Now that we have described the principle of the QTC element and the multiplier, we will turn our attention to the detailed examination of the electrical parameters, the design, and the relationships among the electrical parameters.

5. Calculation of the Sensitivity

Let us first examine the element with the square transfer function. Its operation can be described with the effect chain below:

input voltage → dissipation
dissipation → temperature increase
temperature increase → output voltage

Let us examine each of these effects separately.

The dissipation can be calculated from the input frequency with the expression

$$P_F = U_{in}^2/R_F \qquad (2)$$

where R_F denotes the resistivity of the dissipating element.

The relationship between dissipation and temperature increase is determined by the configuration of the silicon chip (and the capsulation), its specific thermal conductivity, and its heat capacity. In a formal manner, we can describe this relationship with the aid of the thermal transfer impedance concept. If we dissipate the heat output P_A on a part surface A (Fig. 8), and if the temperature of an examined point B increases by ΔT_B as a result, the thermal transfer impedance Z_{AB}^{tt} between the dissipating surface section and the examined point is defined by the expression

$$\Delta T_B = Z_{AB}^{tt} P_A \qquad (3)$$

The dimension of Z_{AB}^{tt} is °C/W. If the dissipation P_A is stationary, the temperature increase ΔT_B is also constant, so that the value of Z_{AB}^{tt} is purely real. If, on the other hand, P_A contains a component that changes sinusoidally with time, ΔT_B will also have a component of this kind. In general, the sinusoidal change of the temperature of Point B is not in phase with the dissipation, and its amplitude will depend on the frequency. Equation (3) also applies to the variable components of the dissipation; however, in this case Z_{AB}^{tt} is now a complex and frequency-dependent quantity.

Assuming that $d \gg r_{AB}$, we may use the following approximating expression for the calculation of the direct-current value of the thermal transfer impedance [8]:

$$Z_{AB}^{tt}\Big|_{\omega=0} \cong \frac{1}{2\pi\sigma_{th}}\left[\frac{1}{A}\int_A \frac{1}{r_{AB}}\,dA - \frac{1}{d}\right] + R_{tok}^{t}, \qquad (4)$$

where σ_{th} denotes the specific thermal conductivity of silicon, A denotes the dissipating area, r_{AB} denotes the distance between the surface section dA and the point B, d denotes the thickness of the chip, and R_{tok}^{t} denotes the thermal resistance of the capsulation.

More precise data on Z_{AB}^{tt} can be obtained from the computer analysis of the heat distribution of the silicon chip.

Finally, the relationship between the temperature increase and the thermopotential (Seebeck voltage) can be expressed as follows:

$$U_S = S\,\Delta T \qquad (5)$$

where S denotes the Seebeck constant. Its value depends on the doping of the semiconductor substance, and has opposite sign for Type n and Type p. Its values for silicon can be found in the diagram of Fig. 9.

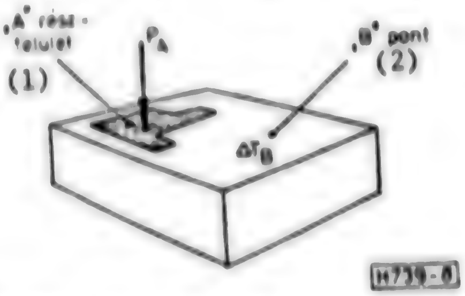

Fig. 8. To be used with tne explanation of the concept of the thermal transfer impedance
Key: 1. "A" Part area
2. Point "B"

Utilizing what we now have, we obtain the following expression for the output voltage of an element with a single sensor, according to Fig. 10:

$$U_{out} = S(\Delta T_1 - \Delta T_2) = S(Z^{tt}_{F1} - Z^{tt}_{F2})P_F \qquad (6)$$

where Z^{tt}_{F1} and Z^{tt}_{F2} denote the thermal transfer impedance between the dissipating element and the contacts (1) and (2).

Utilizing Equation (2), we obtain

$$U_{ki} = S(Z^{tt}_{F1} - Z^{tt}_{F2})\frac{1}{R_F} U^2_{be} = K U^2_{be}, \qquad (7)$$

where we have introduced the sensitivity K of the element QTC.

In the actual design, we used not a single sensor but several sensors connected in series. Figuring with N sensors, we obtain the following final result for the sensitivity of the square transfer layout system:

$$K = N\frac{S}{R_F}(Z^{tt}_{F1} - Z^{tt}_{F2}). \qquad (8)$$

We obtain twice as this because of the factor of two found in the right side of Equation (1). According to Fig. 6, we observed a factor of 1.77 instead of 2 in the experimental circuits. The reason for this is that the three QTC elements are all affected in the given design -- specifically decrease -- even if they are farther away, insofar as the sensors corresponding to the QTC element are concerned.

With these, the sensitivity is

$$K = 0.0425 \text{ mV/V}^2$$

and this agrees satisfactorily with the value of 0.034 mV/V^2 observed on the experimental circuits.

It is also worthwhile to substitute Equation (4) into the expression characterizing the sensitivity:

$$K \cong N \frac{S}{R_F} \frac{1}{2\pi\sigma_{th}} \frac{1}{A} \int_A \left(\frac{1}{r_{A1}} - \frac{1}{r_{A2}} \right) dA, \qquad (9)$$

It is evident that the R^t_{caps} and d are no longer in the final result because of the difference formation of the Z^{tt} impedances in Equation (8). The sensitivity thus indeed is independent of the heat resistance of the capsulation, and -- insofar as the present approximation is concerned -- also of the thickness of the IC chip.

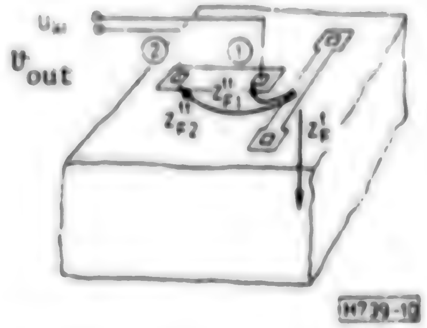

Figure 10. Setup for the calculation of the sensitivity

6. The Temperature-Dependence of Sensitivity

Let us examine the expression characterizing the sensitivity more closely (Equation (9)): Let us seek quantities in it which depend on the temperature. We find three such quantities:

R_F - the resistivity of the dissipating element
σ_{th} - the specific thermal conductivity of silicon
S - the Seebeck constant

The dissipating element is a resistor made by means of diffusion. Its resistivity slightly increases with increasing temperature because of the reduction of the charge-carrier mobility. The temperature-dependence is

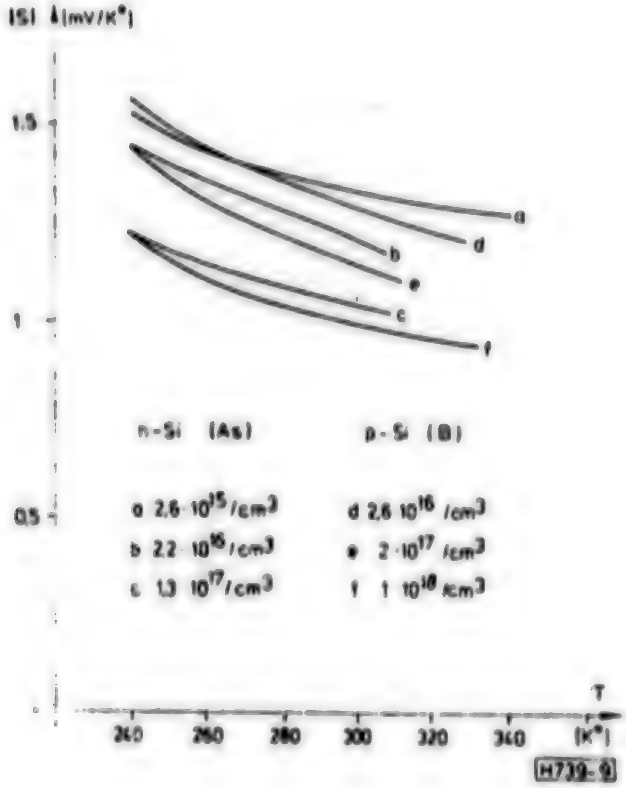

Figure 9. The Seebeck constant for silicon

Let us note that in deriving Equation (8) we have assumed that the individual sensors all have the same sensitivity. This is not quite true in reality since the geometric location of the individual sensors is not exactly the same relative to the dissipating element. For a more precise calculation we would have to determine the Z^{tt} impedances for the "center" and "outer" sensors in Fig. 3 separately.

Let us calculate the sensitivity of the design presented in the preceding section. The resistivity of the dissipating element is $R_P = 2.1$ kΩ. The surface concentration of the p-type diffusion is approximately $10^{18}/\mathrm{cm}^3$; from this, according to Fig. 9, $S = 0.99$ mV/°C. The thermal transfer impedances were found, in a computer-aided calculation, to be $Z^{tt}_{P1} = 18.2$ °C/W and $Z^{tt}_{P2} = 3.2$ °C/W. The number of sensors is $N = 6$.

linear at a good degree of approximation in the temperature range in which we are interested:

$$R_F = R_{F0}(1 + \alpha_R(T - T_0)) \quad (10)$$

where $\alpha_R = 0.001 - 0.002$.

The specific heat-conducting ability of silicon decreases significantly with increasing temperature. On the basis of data from [9], we can derive the following expression for the temperature range between 200°K and 800°K:

$$\sigma_{th} = \sigma_{th0}\left(\frac{T}{T_0}\right)^{-1.31}. \quad (11)$$

From this, we obtain the following linear approximation for room temperature:

$$\alpha_{th} = \alpha_{th0}(1 - \alpha_{th}(T - T_0)) \quad (12)$$

where $\alpha_{th} = 0.00437$.

Figure 9, drawn on the basis of [10], provides clues for the temperature-dependence of the Seebeck coefficient. From this, we obtain as a linear approximation:

$$S = S_0(1 - \alpha_S(T - T_0)) \quad (13)$$

Utilizing the linear approximations according to Equations (10), (12), and (13) in Equation (9), we obtain the final expression for the temperature-dependence of sensitivity:

$$K \cong K_0(1 + \alpha_K(T - T_0)) \quad (14)$$

where

$$\alpha_K = \alpha_{th} - \alpha_R - \alpha_S \quad (15)$$

It is a fact worth noting that members with different sign appear in the α_K factor: α_{th}, R_F, and S; their temperature-dependences thus partly compensate each other.

In our experimental circuit we determined the temperature coefficient of R_F by measurement: $\alpha_R = 0.0011$. For the temperature-dependence of the Seebeck constant we obtained $\alpha_S = 0.002$ from the room-temperature tangent of Curve f. Using these figures, $\alpha_K = 0.00127$. This agrees satisfactorily with the temperature coefficient of 0.0008 to 0.002 for α_K in experimental circuits [11].

The temperature coefficient of the sentivity now established for the temperature range between 10°C and 50°C corresponds to a ±2.5 percent sensitivity change. In applications where this is more than can be permitted, provisions must be made for the compensation of the effect.

7. Operational Error

In the ideal case, the output voltage of the element with square transfer function is exactly proportional to the square of the input voltage: U_{out} U_{in}^2. In reality, the output voltage also contains other members which are proportional to U_{in}^n. The situation is similar for the multiplicand: in addition to the component $U_a.U_b$ for the ideal case, there are additional members which are proportional to $U_a^n.U_b^n$. Because of these members, the circuit does not perform analog squaring or multiplication entirely accurately. Accordingly, the relative magnitude of these members is characteristic for the operational error of the circuit.

Let us first examine the operational error of the QTC element. We regard the actual characteristic of having the following configuration:

$$U_{out} = KU_{in}^2 + K_4U_{in}^4 + K_6U_{in}^6 + \dots \qquad (16)$$

We did not consider the odd powers of U_{in}; the QTC element does not generate such components as a matter of principle. From among the even powers we set ourselves the goal of calculating the multiplication factor of U_{in}^4 since we expect that this provides the predominating part of the operational error.

The operational error is caused by the same factors as is the temperature-dependence of the sensitivity: the resistivity of the heating resistor, and the temperature-dependence of the specific thermal conductivity of silicon and of the Seebeck constant. Let us examine the effects of these factors.

Because of the temperature-dependence of the value of R_F, the dissipation is calculated as follows:

$$P_F = \frac{U_{be}^2}{R_F} \cong \frac{U_{be}^2}{R_{F0}} (1 - \alpha_R \Delta T_F), \tag{17}$$

where ΔT_F denotes the temperature increase of the heating resistor compared to the ambient temperature. If we introduce the thermal impedance Z_F^t between the heating resistor and the capsulation (Fig. 10), this expression becomes

$$P_F \cong \frac{U_{be}^2}{R_{F0}} \left(1 - \alpha_R Z_F^t \frac{U_{be}^2}{R_{F0}}\right), \tag{18}$$

meaning that the member with multiplier U_1^4 is also included for the dissipation. (It should be noted that Z_F^t is actually also temperature-dependent; we disregard this effect since it would merely cause a perturbing member with a power of higher than four.)

The temperature-dependence of the value of σ_{th} means that we need to solve the heat-propagation problem for a thermally nonlinear medium. For the stationary case this can be accomplished easily by means of the so-called Kirchhoff transformation [12]. Omitting the details, we merely state that the following result is obtained for the temperature of Point (1) in Fig. 10:

$$T_1 - T_0 \cong Z_{F10}^{th} P_F + \frac{\alpha_{th}}{2} (Z_{F10}^{th} P_F)^2, \tag{19}$$

where we have employed the approximation (12) for σ_{th}.

Finally, in calculating the output voltage we consider the temperature-dependence of the Seebeck constant as follows:

$$U_S = \int_{T_0}^{T_1} S(T)\,dT,$$

which, using the approximation (13), becomes:

$$U_S \cong S_0 Z_{F10}^{th} \frac{U_{be}^2}{R_{F0}} \left[1 + \frac{U_{be}^2}{R_{F0}} \left(\frac{\alpha_{th} - \alpha_S}{2} Z_{F10}^{th} - \alpha_R Z_F^t\right)\right]. \tag{20}$$

Using Equations (18), (19), and (20) and disregarding the members above U_{in}^4, we obtain the following expression for the thermovoltage of Point (1) in Fig. 10:

A similar expression is also obtained for Point (2). The difference between the two voltages is the output voltage, which, after rearrangement, can be formulated as follows:

$$U_{ki}=K_0U_{be}^2\left\{1+\frac{U_{be}^2}{R_{F0}}\left[\frac{\alpha_{th}-\alpha_S}{2}\,(Z_{F10}^{tt}+Z_{F20}^{tt})-\alpha_R Z_F^t\right]\right\}. \tag{21}$$

The member within the special parentheses next to "1" represents the fourth-power portion of the sought operational error. It is interesting to note that the coefficient of the fourth-power member can be made to equal zero by proper selection of the ratio of the thermal impedances:

$$Z_F^t=(Z_{F10}^{tt}+Z_{F20}^{tt})\,\frac{\alpha_{th}-\alpha_S}{2\alpha_R}. \tag{22}$$

In our experimental circuit, Z_F^t = 50°C/W rather than the desirable 23°C/W; thus, extinction is only partial.

Calculating on the basis of Equation (21), we find that the magnitude of the operational error is very small. Calculating with the data of the experimental circuit, we find that the second member of the expression in special parentheses is less than one tenth of one percent, even if the output voltage is 10 V. The realized circuit had a distortion somewhat higher than this [11]: There was also 2 to 4 promille fourth harmonic in case of fully modulated sinusoidal drive, in addition to the second harmonic output signal.

We calculate the operational error of the multiplier on the basis of the connection diagram in Fig. 4. If we use the approximation, Equation (16), for the individual QTC elements up to the fourth-power member, we obtain

$$U_{ki}\approx 2KU_aU_b+2K_4(2U_a^3U_b-3U_a^2U_b^2+2U_aU_b^3) \tag{23}$$

for the multiplier. This yields the same results for voltages U_a and U_b of identical sign as for the QTC elements. The result is much less favorable if the signs are different.

8. Limit Frequency

Let us consider the diagram of the thermal functional IC (Fig. 1b) and let us find out which effects restrict the operating speed of the circuit. The E → T conversion, meaning the onset of dissipation after start of the U_{in} voltage, may be regarded as free of delay. The same applies to the T → conversion: the thermovoltage follows the change of the sensor temperature without delay. On the other hand, the center block may require considerable time for heat propagation since the heat-propagation medium must be warmed up and it has a finite heat capacity. It follows from the foregoing that the frequency response of the thermal functional IC is determined solely by the frequency response of the heat-propagation conditions. Equation (7) remains valid for the device with the proviso that each and every thermal transfer impedance, including U_{out}, is ω-dependent.

The frequency-dependent thermal transfer impedance may be expressed in the $r_{AB} << d$ approximation as follows:

$$Z^{*}_{AB}(\omega) \approx \frac{1}{2\pi\sigma_m}\,\frac{1}{A}\int_{A}\frac{1}{r_{AB}}\,e^{-r_{AB}\sqrt{j\omega\frac{c}{\sigma_m}}}\,dA + Z'_{1oA}(\omega). \qquad (24)$$

The symbols used are the same as they were in Equation (4); c denotes the specific heat capacity in Ws/m^3. Calculating with these expressions, we obtain the frequency response illustrated in Fig. 11 for our realized QTC element (continuous line). We have also examined the frequency response of the circuit: the circles in the figure show the results. It can be seen that the 3 dB limit frequency (f_{0out}) of the QTC element exists at a frequency of approximately 8 kHz for the output voltage. The limit frequency of the multiplier combined from three QTC elements is the same.

It must be emphasized that this limit frequency manifests itself only relative to the output signal! Only the parasitic capacitance of the heater resistance, the inductivity of its connections, and the parasitaries of the capsulation limit the frequency of the input signals. With conventional IC capsulation this means several tens of MHz limit frequency; with device capculations used at very high frequencies, the GHz range may even be reached. Accordingly, Fig. 12 illustrates the frequency-dependent characteristics of the device (it is an equivalent pattern). Up to the limit frequency f_{0in} (which is quite high), the device performs the analog operation without error (squaring and multiplication); however, the results appear undamped at the output only below the relatively small limit frequency f_{0out}.

The f_{0out} = 8 kHz limit frequency applies to our experimental circuit with a line width of 12 μm; it could be increased by proportional reduction of the structure. The argument of the exponential factors in Equation (24), containing the ω, is

$$-r_{AB}\sqrt{j\omega}\sqrt{\frac{c}{\sigma_m}},$$

This means that if the dimensions are reduced n-fold, the value of the argument will be the same at an ω value n^2 times as high. The limit frequency f_{0out} thus increases quadratically with the reduction of the dimensions. At a line width of 4 μm, which is customary today, this means a limit frequency of approximately 70 kHz. As a matter of fact, it is possible to achieve line widths of 1 μm, so that frequencies f_{0out} of the MHz range are feasible.

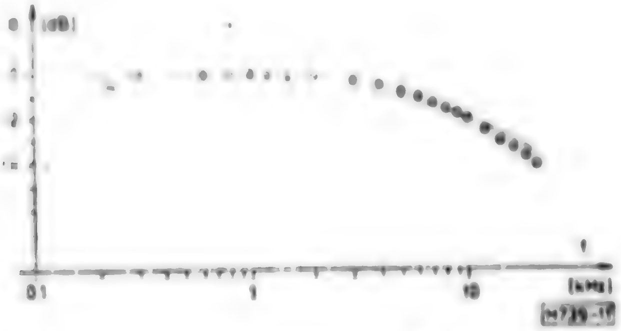

Figure 11. Frequency response of the sensitivity of the QTC element. Continuous line: calculated; circles: measured

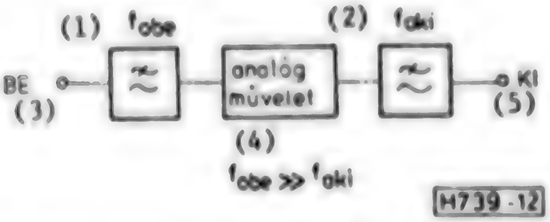

Figure 12. Equivalent pattern for the frequency-dependent characteristics of the QTC element

Key: 1. f_{0in}
2. f_{0out}
3. IN
4. Analog operation
5. OUT

It should be noted that the proportionate reduction of the dimensions also affects the sensitivity of the device in a favorable manner: the value of K increases linearly with the reduction of the dimensions.

9. Noise Characteristics

The output signal of our realized functional circuit appears on the realized sensors in the form of diffused resistivities. To the signal there is added the resistivity noise formed on the sensor:

$$n_{eff} = \sqrt{4kTR_E f_{0out}} \tag{25}$$

where R_E denotes the totalized resistivity of the sensors. We regarded f_{0out}, meaning the maximum frequency range of the output signal, as the bandwidth. It can be seen that the value of R_E must be reduced if we are to improve the noise characteristics. Our experimental circuit still has some hidden reserves in this connection. In the design illustrated in Fig. 3, we could still reduce the series resistivities without relocating the contact points of the sensors.

Calculating with the data of the experimental QTC circuit we obtain 0.87 μV for the noise voltage. This, combined with the maximum output voltage, gives a noise-to-signal ratio of 76 dB. The same for the multiplier circuit is 68 dB.

Although the value of R_E remains unchanged if we reduce the dimensions linearly, the bandwidth of the useful output signal increases. As a result, the noise voltage obtained from Equation (25) increases also. At a line width of 4 μm, the noise-to-signal ratio of the QTC element is only 67 dB.

10. Possible Applications

It appears that the thermal multiplier circuit may be used to advantage in all cases where analog multiplication with a relatively narrow bandwidth is required. The same applies to square transfer function elements. Here we present some examples for these applications.

Analog ratio formation and square-root determination. The ratio formation and square-root determination operations can be realized by connecting the multiplier or the QTC element in the feedback circuit of the operational amplifier (Fig. 13). But we must exercise care to ensure that the feedback never becomes positive. For this reason, the ratio former described can be used only in case of a positive U_{in2}, and this is also why a diode must be connected in series with the output of the circuit of the square-root forming circuit.

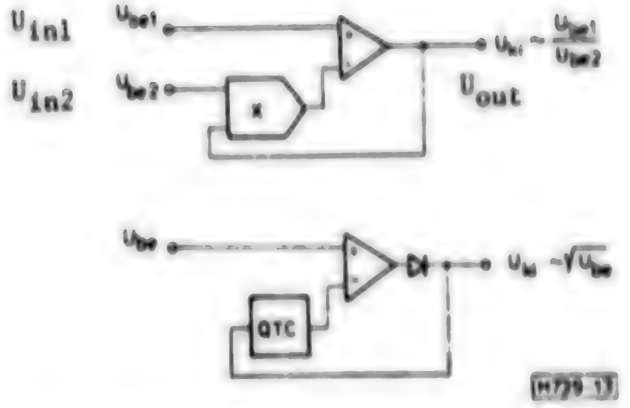

Figure 13. Ratio formation and square-root determination with multiplier or QTC element

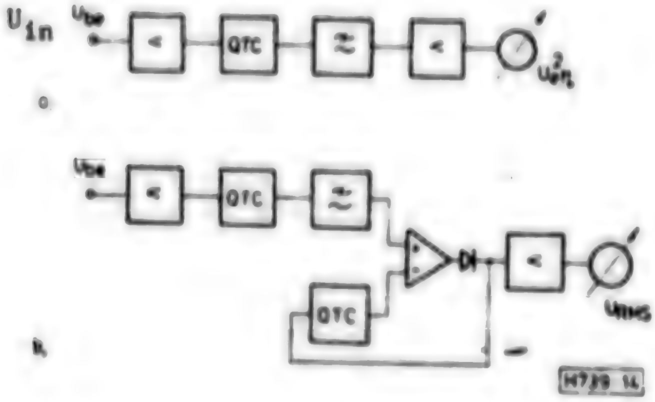

Figure 14. Effective-value meters with QTC element

Effective-value meter. The simplest solution is illustrated in Fig. 14a. The QTC element generates the square of the signal to be measured; detachment of the mean value is accomplished via a low-pass filter. This approach has the disadvantage that the instrument scale is quadratic. By combining the circuit, as illustrated in Fig. 14b, with a root-forming device, we obtain an effective-value meter with linear scale (RMS meter). The QTC element may also be considered as an effective-value meter in the microwave range.

An effective-value meter with especially low noise may be built with the aid of the analog multiplier. The layout is illustrated in Fig. 15a. The voltage to be measured is amplified by two identical amplifiers, and their outputs are fed to the thermal multiplier. The instrument measures the mean square of the input signal. The noises of the input amplifiers are independent of each other, meaning that they cancel each other out in the course of product formation and averaging. Building the circuit from conventional elements, we could readily achieve an equivalent input noise impedance of less than 100 ohms in the audiofrequency range [13].

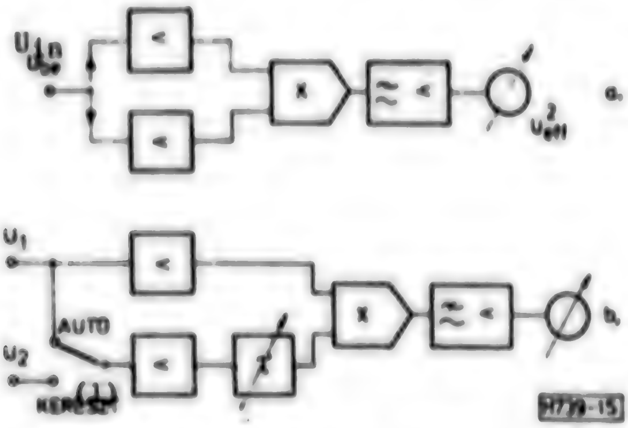

Figure 15. Effective-value meter with low noise (a) and correlation meter (b) realized with thermal multiplier

Key: 1. Cross

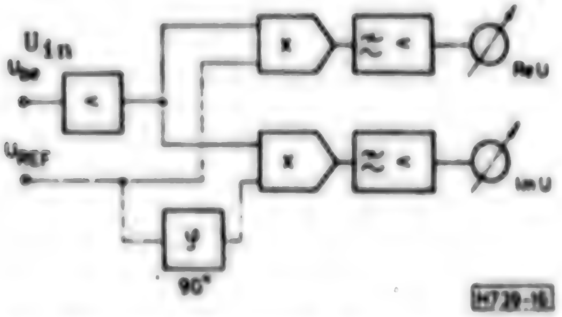

Figure 16. Vector voltmeter realized with thermal multiplier

Auto- and cross-correlation meter. Minor modifications of the above circuit make it suitable for measuring auto- and cross-correlation functions (Fig. 15b).

The mean $u_1(t).u_2(t-\tau)$, the correlation function, can be measured as a function of the variable delay τ inserted in one amplifier branch. The noise of the amplifiers is eliminated from the results of the measurements in this case also. The delay can be conveniently realized by means of a bucket-brigade circuit or by other means.

Vector voltmeter. The layout illustrated in Fig. 16 can be used for the vectorial measurement of sinusoidal voltages. Two separate instruments measure the component in phase with the sinusoidal reference signal and the other component which is delayed by 90° relative to the former. The bucket-bridage circuit can be used here also for realizing the delay.

Spectrum analyzer. The circuit illustrated in Fig. 17 can be used to take the frequency spectrum of the input signal. An analyzer of this type can be realized with the thermal multiplier from the ultrasonic to the microwave region. The resolution is determined by the bandwidth of the low-pass filter connected after the multiplier.

Frequency doubler. The circuit illustrated in Fig. 18a can be used to exactly double the frequency of the sinusoidal input signal. It is based on the expression

$$\cos^2 \omega t = \frac{1}{2} + \frac{1}{2} \cos 2\omega t$$

Only d.c. component forms at the output in addition to the signal with twice the frequency. Consecutive doublings can also be realized by amplification between the individual stages and detachment of the d.c. member (Fig. 18b). A possible application of this circuit is in the field of electronic music instruments.

Modulator, demodulator. Generation and demodulation of amplitude-modulated signals can be accomplished with the aid of the thermal multiplier circuit. As an example, Fig. 19 illustrates the generation and demodulation of a double-sideband signal with suppressed carrier. In case of modulation, both the carrier and the modulating signal must be below the limit frequency of the multiplier output. In case of demodulation, on the other hand, the carrier frequency is limited only by the input limit frequency of the multiplier, which is larger by several orders of magnitude.

The author desires to express his thanks at this time to all those who contributed to the thermal-multiplier project: primarily to Katalin Solt, Jozsef Harsanyi, and Dr. Janos Mizsei -- who realized the IC -- and to former pupils Edit Hadfi and Dezso Beneskoczy, who helped with applications.

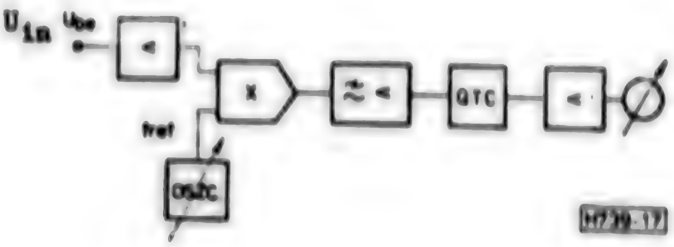

Fig. 17. Spectrum analyzer

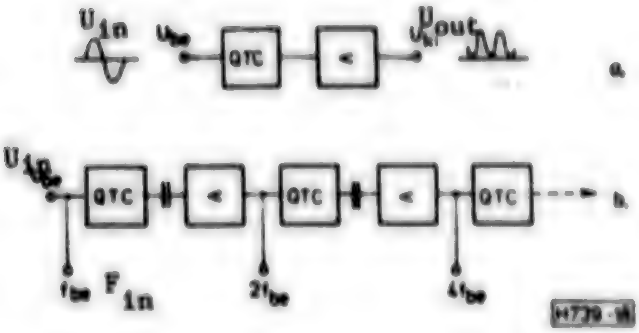

Fig. 18. Frequency doubler and multiplier

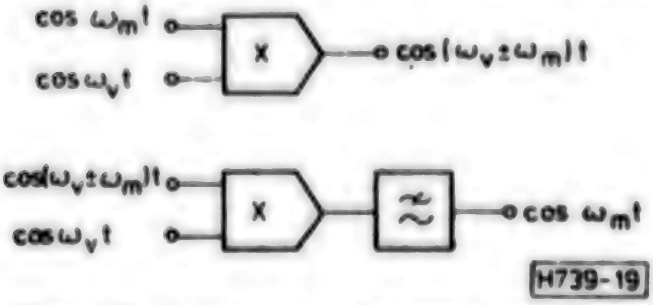

Fig. 19. Modulator and demodulator realized with the thermal multiplier

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THE THORIUM B CONCENTRATION OF THE ATMOSPHERE AND ITS RELATIONSHIP TO CERTAIN METEOROLOGICAL PARAMETERS

Budapest IDOJARAS in Hungarian Vol 85 No 5, Sep-Oct 80 pp 268-276

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[Abstract] Daily measurements of the Th B concentration in Budapest were made between 16 January 1979 and 15 January 1980. Minimum levels (0.03 and 0.15 Bq/m^3) were observed in January and June; maximum levels (0.27 and 0.24 Bq/m^3), in September-October and March. The mean annual level was 0.17 Bq/m^3). The daily Th B concentrations showed a Gaussian distribution (values corresponding to the frequency of 50 percent were: 0.085 Bq/m^3 in the winter, 0.206 Bq/m^3 in the spring, 0.155 Bq/m^3 in the summer, and 0.212 Bq/m^3 in the fall. The snow cover restricted exhalation during the winter; in other seasons, the moist soil surface and washout from falling precipitation reduced the radioactivity of the aerosol particles. Other than during the winter months (when there was a linear correlation between soil temperature and aboveground Th B concentration), the soil temperature did not affect the readings. There was negative linear correlation between cloud cover and Th B concentration. The wind affected the results, primarily the distribution: the effect depended on the wind direction (whether it blew from or toward urban areas) and on the wind velocity (there was negative correlation in case of southeast winds). Increased precipitation generally reduced the Th B concentration except if there was snow cover (when it had no effect). There was no clear-cut relationship between Th B concentration and atmospheric temperature. The particle-size distribution of the aerosol particles was not investigated. Figures 6, references 10: 2 Russian, 3 Hungarian, and 5 Western.

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ISOLATION OF STACHYBOTRYS TOXINS (Preliminary Report)

Budapest MAGYAR ALLATORVOSOK LAPJA in Hungarian Vol 35 No 12, Dec 80 pp 817-819
manuscript received 22 Nov 79

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[Abstract] Of 13 Stachybotrys strains, 2 skin test-positive, highly toxic strains (D-36 and "Jaszapati" ATCC-34915) were selected for the study. These had been isolated by Danko and Palyusik from seriously ill animals. The strains were grown on autoclaved oat or rice, dried, ground, extracted with diethyl ether and precipitated with n-hexane. After filtering the precipitate, the process was repeated on the evaporated solvent residue and the precipitates were combined. This was extracted with a n-hexane-methanol-water mixture. The aqueous phase was again extracted with an ethyl acetate-chloroform mixture, evaporated and redissolved in chloroform followed by purification on silica gel 60 ("Jaszapati") and Sephadex LH-20 (D-36) columns. The combined toxic fractions were chromatographed on a silica gel 60 column with a chloroform-isopropanol mixture. The individual toxins were separated by thin layer chromatography on silica gel 60 F_{254} (Merck) plates. Each strain yielded four fractions with identical Rf values for both strains. The fractions were highly toxic to brine shrimp. On the basis of their UV absorption peaks between 255 and 260 nm, their specific color reaction characteristic of trichotecenes and their strong cell toxicity, and also of the procedures used for their isolation, the toxins are presumed to be macrocyclic trichothecenes. Determination of their chemical composition is in progress. References 22: 7 Hungarian, 4 Russian, 11 Western.

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SIMULTANEOUS OCCURRENCE OF ANTIBIOTIC RESISTANCE AND ENTEROTOXIN PLASMID IN ENTEROPATHOGENIC ESCHERICHIA COLI BACTERIA ISOLATED FROM SWINE AND THEIR TRANSFER

Budapest MAGYAR ALLATORVOSOK LAPJA in Hungarian Vol 35 No 12, Dec 80 pp 820-823
manuscript received 2 Apr 80

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[Abstract] Of the 351 porcine enteropathogenic strains of E. coli submitted to two central institutes of veterinary hygiene and research between 1975 and 1978, 85 percent carried a factor of resistance to antibiotics. Resistance to tetracycline, chloramphenicol, streptomycin, neomycin, kanamycin, polymyxin-B and nitrofurantoin was tested. To study transferable resistance, 28 enterotoxic E. coli donor strains and 5 multiresistant strains not producing enterotoxin were used. A modified Tschape and Rische method was used for conjugation. With a suitable recipient strain, 36 percent of the strains transferring R plasmid also transferred the enterotoxin plasmid. It was concluded that the incorrect use of antibiotics still effective today can lead to the development of new pathogenic E. coli strains which are not only multiresistant but also produce enterotoxin. Diseases caused by such strains are virtually impossible to treat. References 35: 7 Hungarian, 1 East German, 27 Western

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UDC: 621.3.049.75.088.6:681.326.7

INTERACTIVE GRAPHIC PROGRAM FOR THE MODIFICATION OF THE PATTERN OF PRINTED CIRCUIT BOARDS

Budapest MERES ES AUTOMATIKA in Hungarian Vol 28 No 12, 1980 pp 350-455 manuscript received 20 Nov 78

KERESZTELY, Domokos, and TOLNAY-KNEFELY, Tibor, Digital Department, MTA SZTAKI [Hungarian Academy of Sciences, Computer-Technology and Automation Research Institute]

[Abstract] The program, written in the assembly language for the TAP 70 computer, makes it possible to delete parts of the drawing, to insert new elements, and to geometrically transform parts of the drawing related to each other by selectable criteria. While performing these functions, the program monitors whether the operator has introduced discontinuities or short circuits. The input may be the wiring diagram of the printed circuit board (designed on a large computer); its output may be the input information of the post-processor program that prepares the control tape of a numerically controlled machine tool. The program supplements the designing program (which handles only integrated-circuit modules so that discrete components and connections must be provided separately, and which sometimes utilizes more than the available space: for either reason, subsequent modifications are necessary). After the program has been loaded, the individual segments (such as display, enlargement, deletion, and insertion) and functions (such as component addition, line-thickness modification, highlighting, and interrogation) are activated by commands entered on the control console. The TPA 70 small computer has a 16K word operating memory; the pattern is displayed on a GD'71 graphic display. The input data are provided on punched cards, and the output may be provided on magnetic disk and/or punched card. Documentation may be had via a line printer. The program is based on the GZU program prepared by the Automation Section for the Machine-Manufacturing Industry of the authors' institute. Figures 12, references 8: 1 Western and 7 Hungarian.

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BRIEFS

INTERFERON PRODUCTION ASSOCIATION--A research-development organization for domestic production of Interferon has been established. It consists of the United Pharmaceutical and Nutriments Factory (EGYT), the Institute of Microbiology of Szged Medical University and the National Institute of Hematology and Blood Transfusion. Interferon is expected to be a potent antiviral and anti-cancer agent. The first task of the recently established organization will be to evolve a process for producing a highly pure form of Interferon suitable for human medicine. The sterile plant where production is to begin no later than the second half of 1981 will be set up at one of the plants of EGYT. The white blood cells required for the process will be contributed by the Institute of Hematology and Blood Transfusion. The program calls for production and sale abroad of several million units of unrefined Interferon in 1981. The proceeds from said sales are to be used to finance continued research. Researchers hope to be able to produce sufficiently pure Interferon by 1982 to use for experimental purposes at Hungarian institutions designated for such tests by the Ministry of Health. [Text] [Budapest NEPSZABADSAG in Hungarian 15 Feb 81 p 21]

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